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by

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BOOK FIVE

THE FLOWER

by
GWEN CROSS

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NOTE ON THE USE OF THE BOOK

Chapters are divided into:

1. The Lesson.
2. Things to do and/or
3. Questions.

The main point of this book is the practical work in the garden and class room. Emphasis should be laid on:

1. Careful observation.
2. Clear, big, tidy records and drawings in the class room and books.

The drawings are diagrams. They should be drawn on the blackboard, piece by piece, slowly, while the class copies, piece by piece. The names should be written clearly, straight, and one under the other. Full directions should be given as to the size and spacing of diagrams, etc.

The book may be taken as it stands by any class whose English is sufficient.

The course can also be taken with a junior class which does not know much English yet, but can read and write in some language, and is beginning to "awake," i.e. at the end of the first year or in the second year at school. At this stage the English reading of the lessons and the answering of the questions in English are omitted. The lessons and questions can be used as a Reader and for revision later if desired.

PART ONE

THE FLOWER

CHAPTER I

THE LILY

BEFORE THE LESSON

Collect the flowers of the white spider lily. If you cannot get this, take any other flower that shows the parts as described in this lesson.

LESSON

In many plants the flower is the part that we see most easily. This is because the flower leaves are often brightly coloured. These leaves are called *petals*. Outside the petals in some flowers there are green leaves. These are called *sepals*. They fold round the petals and protect them when they are still in the bud. When the flowers open the sepals sometimes fall off. Each part of a flower has its own work to do. We can read about this work in the second part of this book—*The Story of Pollen*.

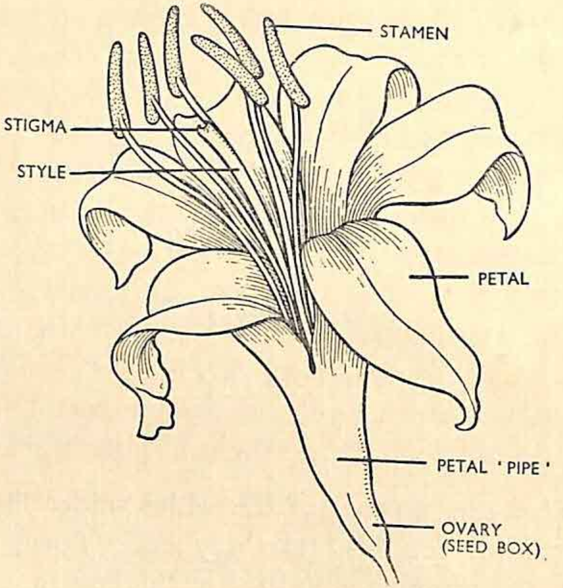

FIG. 1. FLOWER OF THE RED LILY

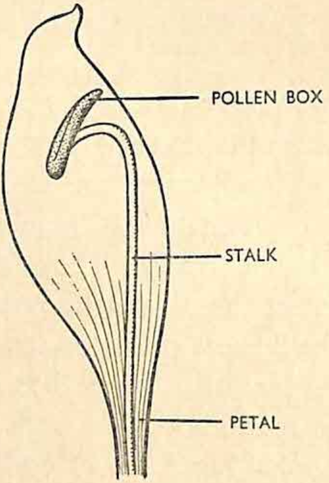

FIG. 2. STAMEN OF THE RED LILY

The white spider lily flower has six white petals, three of them outside the other three. These petals join together to make a "pipe." In some flowers the petals join like this and in others they do not. At the bottom of the "pipe" is a little sweet sticky juice. We call this honey. Insects visit flowers to get this honey.

Inside the petals there are six long very thin stalks. These grow on the petals. On the end of each stalk is a box. In the box is a yellow powder. This is *pollen*. The box is the pollen box. The long stalk and pollen box together make the *stamen*. In the flower bud the petals are folded together like a blanket to protect the stamens from rain and cold.

THINGS TO DO

1. Take some white spider lily flowers. Cut off carefully the petals and pipe in one piece. Open them out flat. Draw them (Fig. 1 is a drawing of a red lily).
2. Take off the six stamens. See in which direction the boxes open, outwards or inwards, to the middle of the flower. Are the pollen boxes joined to the stalks from the centre so that the boxes swing, or are they joined at one end? Draw and name one stamen, pollen box, and stalk (Fig. 2).

QUESTIONS

1. What are the sepals of a flower?
2. What is in the box of the stamen?
3. What is the sticky juice at the bottom of the petals?
4. Are the petals joined to make a pipe in all flowers?
5. Write down the names of five plants that have coloured petals.
6. How are the stamens protected in the bud?

CHAPTER II

THE LILY
(continued)

BEFORE THE LESSON

Collect lily flowers again. Collect some that are dead, with big seed boxes.

LESSON

In the middle of the flower there is a long thin stalk with no pollen box on it. It is part of the seed box and is joined to it. It is like a long neck. It is called the *style*. In some flowers the style is short. In some flowers there is more than one style.

At the top of the style there is a little head. This is called the *stigma*. Sometimes it is sticky. Sometimes there are pieces of yellow pollen on it.

Under the petals is the *stalk* of the flower. In this lily the stalk is swollen. This swollen part is named the seed box or ovary, because it contains the ovules (meaning small eggs) which grow into the seeds of the plant. In some flowers the seed box (which we shall call the ovary) grows above the petals, but in this one it is under them.

In the young ovary there are very small things that will become *seeds* by and by. The ovary keeps the seeds dry. When the seeds get bigger the ovary also gets bigger. It becomes ripe. When it is ripe the seeds are ready to grow. A ripe ovary is called a *fruit*.

THINGS TO DO

1. Take off petals and stamens from one flower. Look at the ovary, style and stigma. Draw these (Fig. 3). Name the three parts.

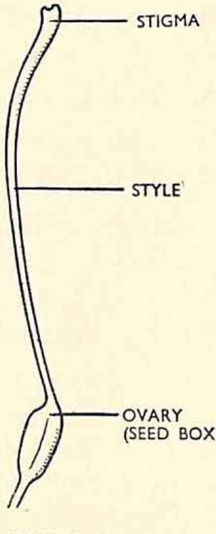

FIG. 3. STIGMA, STYLE AND OVARY OF THE RED LILY

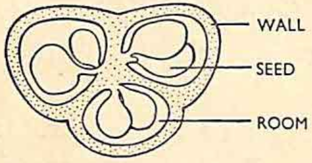

FIG. 4. OVARY CUT CROSSWAYS

2. Cut a big ovary in half crossways. Look at the three rooms in the ovary and at the seeds. Draw a diagram of the cut half (Fig. 4). Name the ovary wall, one room, the seeds.

3. Cut an ovary in half longways. Look how the seeds grow. Draw and name a cut half (Fig. 5).

4. Take a flower bud. Open it. Look at the folded petals, the stamens and the style.

5. Look at flowers:

(*a*) Just open.
(*b*) Open wide.
(*c*) Dying.
(*d*) Dead.

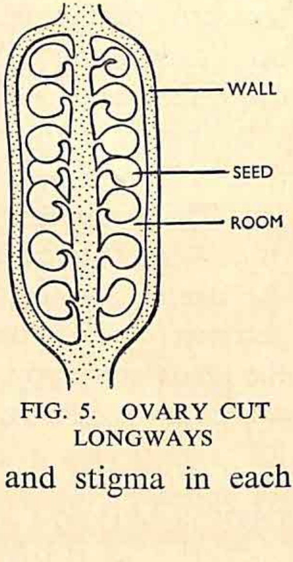

FIG. 5. OVARY CUT LONGWAYS

Look at the stamens, style and stigma in each flower. What do you see?

QUESTIONS

1. Write down the names of all parts of an ovary.
2. What is a ripe ovary called?
3. How many rooms are there in the ovary of the lily?
4. Go round the garden. Look for other flowers that have the ovary under the flower. Write down the names of three.

CHAPTER III

THE PUMPKIN STAMEN FLOWER

BEFORE THE LESSON

Collect pumpkin flowers that have a yellow cone in the centre with yellow pollen. Do not collect those that have three yellow arms in them and a swelling under the flower.

LESSON

Many flowers have stamens and ovaries in the same flower. Hibiscus, lily, cow pea are like this. But some plants have ovaries and stamens in different flowers. The pumpkin, maize and the coconut are like this. Some plants have ovary flowers and stamen flowers on different plants. The pawpaw is like this.

In the pumpkin stamen flower we see:

(*a*) The five green sepals joined to make a cup.
(*b*) Five big yellow petals joined to make a cup.
(*c*) Many stamens. The stalks are joined to make a thick pipe. The stamens grow very near

together in straight lines all over the pipe. There is no ovary in the flower and no swelling under the flower.

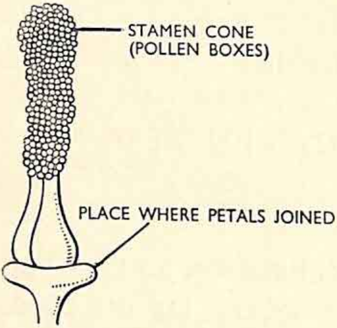

FIG. 6. STAMEN CONE

THINGS TO DO

1. Find a stamen flower in the garden (Fig. 6). Take off the sepals and petals. Draw the stamen cone. Cut the cone in half longways and look at it.

CHAPTER IV

THE PUMPKIN OVARY FLOWER

BEFORE THE LESSON

Do not cut ovary flowers off the plant because then you will not get the pumpkin fruits. Instead you must go to the garden to see the ovary flowers there.

LESSON

The sepals and petals are like those in the stamen flowers. There are no stamens. Under the flower there is a swelling in the stalk. This is the ovary. Sepals and petals join the flower above the ovary. The style is in the middle of the flower. It is very short. The stigma is divided into three arms. These are thick and sticky. Inside the ovary there is only one room. The seeds grow in three groups round the wall of the room.

THINGS TO DO

1. In the garden take off the sepals and petals of an ovary flower. Look at the stigmas, the short style and the ovary. Draw this (Fig. 7). Name the parts.

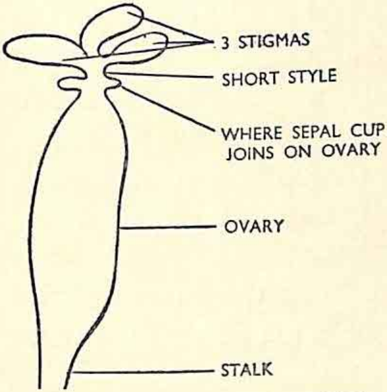

FIG. 7. OVARY AND STIGMA

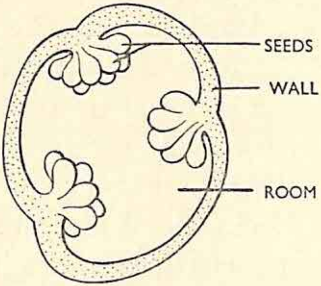

FIG. 8. PUMPKIN FRUIT CUT IN HALF

2. Cut a ripe pumpkin in half crossways (Fig. 8). How do the seeds grow? How many rooms do you see?

3. Draw a diagram of the ovary, style and stigmas. Name the parts.
4. Watch pumpkin plants grow. Which flowers do you see first: stamen or ovary flowers? Of which flowers are there more? Of which are there fewer?
5. Look at the maize in the garden. Look at the stamens growing from the branches at the top of the plant, and the ovaries ripening in cobs in the leaf axils.
6. Get a flowering branch from a coconut. Look at the stamen flowers at the top. See a few young coconuts still very small on branches near the bottom. Do you see sepals and petals?
7. Look at a banana bud that is opening. Find the ovary flowers and stamen flowers.
8. Look at two different sorts of flowers on two different sorts of pawpaw trees. Find stamens in one sort and ovaries in the other sort of flowers. How many sepals, petals, and stamens are there? How many styles and stigmas?
9. Go round the garden. Find three flowers with stamens and ovaries in the same flower, and three with them in different flowers.
10. How do the seeds grow in:
    - (*a*) the hibiscus,
    - (*b*) the cow pea,
    - (*c*) the pumpkin,

(*d*) the lily?

Draw a little diagram of each ovary cut in half crossways.

PART TWO

THE STORY OF POLLEN

CHAPTER V

AN OVARY (SEED BOX)

LESSON

Many flowers have four parts:

1. Outside green leaves.
2. Coloured or white leaves called petals.
3. Pollen boxes with pollen.
4. Ovaries with seeds.

An ovary is divided into three parts: (*a*) the box (ovary), with the seeds, (*b*) a neck, called a style, (*c*) a head, called a stigma (see Fig. 3).

The neck may be very long: the red lily flower is like this. The neck may be very short: the pumpkin flower is like this. There may be more than one neck: the hibiscus flower is like this. Sometimes there is one stigma, and it is like a pinhead, and it is sometimes divided into two, three, four, or many parts. The stigma in the pumpkin flower is divided into three parts. In the hibiscus flower there are five stigmas. Each head is on a long neck.

If we cut the ovary of a flower that has not yet opened, we shall see in it little white things. These will be seeds by and by. When they are very young like this, we call them *ovules*, which means small eggs.

THINGS TO DO

1. Collect flowers from the garden, and find the green leaves, petals, stamens, ovary.
2. See if you have found any flowers that have not all these parts.
3. Look at the hibiscus flower. Find out how many stamens, styles, and stigmas it has.
4. Look at the pumpkin flower. How many parts is the stigma divided into? Find a flower with only stamens, and one with only an ovary.
5. Cut in half the ovary of a lily or hibiscus flower when it is still a bud. Look at the little white ovules (Fig. 4).

CHAPTER VI

POLLEN AND POLLINATION

The First Journey of the Pollen

LESSON

The pollen boxes and their stalks are called stamens. In the pollen boxes there is a yellow powder. It is called pollen. Pollen helps to make seeds.

If pollen does not go on to the stigma, the little ovules cannot become seeds. Then that flower will not have any fruit. The head of the ovary is often sticky. The pollen easily sticks to it.

Sometimes the pollen in one flower goes on to the stigma of that same flower. We call this self-pollination, because the flower has done this itself.

Sometimes the pollen of one flower is carried to the stigma in a different flower. We call this cross-pollination, because the pollen is carried across from one flower to another.

QUESTIONS

1. What is in the pollen boxes of flowers?
2. What is in a young ovary?
3. What is in a ripe ovary?
4. What makes the ovules become seeds?
5. What is meant by self-pollination?
6. What is meant by cross-pollination?

CHAPTER VII

SELF-POLLINATION

The Journey of the Pollen in One Flower

LESSON

Some flowers are always self-pollinated. In these flowers the stamens are sometimes above the stigma. Then the pollen can fall down on to it. Sometimes the stamens bend and touch the stigma. Sometimes an insect goes into the flower. The pollen goes on to its head, or back, or legs. When the insect goes out of the flower it rubs this pollen on to the stigma of the same flower.

Some flowers pollinate themselves if the pollen from another flower does not come to them. Some flowers of the legume family are like this.

Sometimes the stigma is ready for pollen before the pollen in that flower is ripe. The pollen is ripe later, before the stigma withers. If an insect has not come to the flower, the ripe pollen then gets on to the stigma.

Some flowers can never pollinate themselves because pollen boxes and ovaries are in different flowers, or because the pollen and stigmas in one flower are never ripe at the same time.

THINGS TO DO

1. Go round the garden and try to see what flowers could be self-pollinated. They will be flowers that have pollen and an ovary in the same flower. The pollen and stigma are ripe at the same time. The pollen must be able in some way to get on to the stigma of that flower.
2. Write down the name of any flower that you find like this.
3. When you find a flower that the class thinks could be self-pollinated, make some little bags with leaves, thin calico or soft paper. Make the bags big enough for the flowers to be able to open inside them. Cover three or four flowers with them. Wait until the flowers have opened and are withering. Watch to see if these flowers have ripe ovaries. If they have, they will have been self-pollinated. You must watch carefully to see that

pollen is not carried into the flowers by very small ants or flies.

4. Watch some flowers to see what the stamens and necks of the ovaries do. (Bend? grow longer? turn round? etc.) Do this only with big flowers whose parts you can see easily.

CHAPTER VIII

CROSS-POLLINATION BY THE WIND

The Journey of the Pollen from one Flower to a different Flower: Carried by the Wind

LESSON

Pollen is carried from one flower to another by the wind or by insects, butterflies, bees, little flies or ants.

Plants that have the pollen carried by the wind do not have coloured petals. They do not make honey. They do not smell. They are often small, and not easy to see. They make very much light, dry pollen which is easily carried by the wind. Some of this pollen is lost, but it does not matter because they make so much of it that some will go on to the stigmas of other flowers. Some flowers pollinated by the wind have big stamens on long stalks. The stamens then hang out of the flower and the wind blows away the pollen. These flowers also often have long styles and there are several stigmas. This also helps the flower to get the pollen that comes to it in the wind. See Figs. 9 and 10 illustrating stamen and ovary flowers of the maize.

THINGS TO DO

1. Name three insects that can carry pollen.
2. Go round the garden. Write down the names of any plants whose pollen you think is carried by the wind (maize, grasses).
3. Which of these plants—grasses, maize, pawpaw—
    (*a*) has stamens and ovaries in the same flower?
    (*b*) has them in different flowers but on the same plant?
    (*c*) has them on different plants?
4. Look at a coconut flower branch that has fallen. Find the stamen flowers at the top of the branch, and a few ovaries at the bottom. These flowers are pollinated by the wind.

QUESTIONS

1. If you saw a big flower with a nice smell, and another small flower with no smell and no colour, which do you think would have the pollen carried by the wind?

2. Do wind-pollinated flowers make honey?
3. What do they have so that the pollen can get easily on to the stigmas?

CHAPTER IX

A WIND-POLLINATED FLOWER: MAIZE

Maize has two kinds of flowers on one plant. At the top of the stem, there are a few thin branches. On these branches, there are flowers with stamens, but no ovaries.

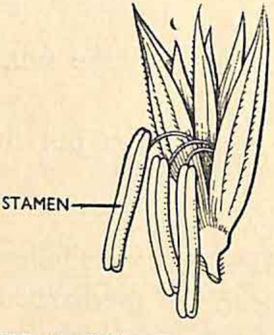

FIG. 9. STAMEN FLOWER OF MAIZE

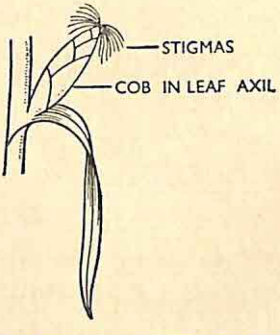

FIG. 10. OVARY FLOWER OF MAIZE

On the side of the stem, between the leaves and the stem there are the cobs. In the cobs there are many little flowers. These have ovaries but no stamens.

The pollen flowers are very many. Each flower has some dry, little petals that are a yellow-brown colour. When the flowers open, three big stamens hang out from each flower on very thin stalks. Stamens open and the pollen falls out. Then the stamens die and fall from the flower. The petals become very dry and tough.

When they are young, each ovary flower has a few soft white little petals and a soft white ovary. The ovary has a very long style. This is white in the young cob. At the top of the cob, the long styles hang out. In the beginning they are pink, then red, then they die and are brown. The styles lie in straight lines between the lines of ovaries. These long styles have stigmas that catch the pollen blown to them from the stamens. When maize is ripe, we see the little petals left on the cob.

THINGS TO DO

1. Go into a corn (maize) garden. Find some pollen flowers that are not yet open. The branches of these flowers may be still folded together.
2. Find some pollen flowers that have opened. Look at the stamens. Try to take one flower off the branch. Look at the dry petals and the three stamens. Has this flower any smell, or bright colour?
3. Look at the different colours of the tassels on

the corn cobs. What are these tassels? When are the tassels dark brown?

4. Break off a little piece of the top of a young cob. With a needle take out one young white ovary. See the soft white petals round it.

5. Open carefully a young cob that is ready to eat. Look at the styles, one from each seed box, lying in long straight lines.

QUESTIONS

1. Where are the stamen flowers in the maize?
2. Where are the ovary flowers in the maize?
3. Do the flowers have honey bags?
4. What carries the pollen from the stamens to the stigmas?
5. Name a flower that has very long styles.

CHAPTER X

CROSS-POLLINATION BY INSECTS

The Journey of the Pollen from one Flower to a different Flower: Carried by Insects

LESSON

Flowers that are pollinated by insects are often big, they have bright colours, and a nice smell. The pollen is sticky and it sticks easily on to the legs, backs, heads or chests of insects.

In these flowers there are little bags of honey at the bottom of the petals. When the pollen in a flower is ready, the honey is also ready. Honey is the food of many insects. Insects see the bright colour of the flowers, or they smell them. The colour, size and smell of a flower tell the insect which flowers have their pollen and honey ready.

Little insects—flies and ants—fly to the flowers or walk up their stems. Then they walk into the flowers. Bigger insects—butterflies and bees—fly to the flowers. They sit or stand on the petals. They put their long "tongues" down into the flowers to suck the honey.

When they go into a flower, pollen may fall on to their legs, backs, heads or chests. The pollen is sticky. When the insect has taken the honey it wants, it goes out from the flower and takes the pollen with it.

Insects visit one flower after another. When they go into another flower, they rub some of the pollen from their bodies on to the head of the ovary of that flower.

In this way pollen is carried by insects from flower to flower. The colour, smell and honey are all part of God's plan to bring the insects to the flowers. If insects do not go to these flowers, the pollen is not carried and the ovules cannot become seeds.

In these flowers God has put the stamens and stigmas so that the pollen will be carried away to a different flower and cannot go on to the stigma of the same flower. Sometimes pollen and stigma ripen at different times. Sometimes they are in different flowers. We think that cross-pollination helps to make strong seeds. Pollen can make seeds only from ovules of the same kind of plant. Pumpkin pollen will not help water melon ovules. That is why one kind of insect often visits only one kind of flower. Cow peas are visited by little white butterflies. Pumpkins are visited by small flies or bees. If flies do not visit them, then we must put the pollen into the ovary flowers to help them make seed and fruit.

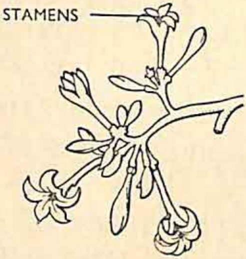

FIG. 11. STAMEN FLOWER OF PAWPAW

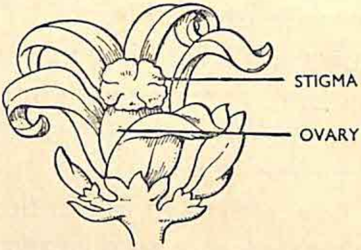

FIG. 12. OVARY FLOWER OF PAWPAW

THINGS TO DO

1. Find a flower of a kind pollinated by insects.

Tie a young bud in a little bag. See that no insects can get inside the bag. If fruit does form, make sure that the bag was properly tied on. If it was, try to find out by watching other flowers of the same kind how pollination might have taken place.
2. Watch the garden flowers. Write down the names of the insects which visit each kind of flower.
3. Look at the two kinds of pawpaw flowers. In which flowers are there stamens? In which is there a seed box? Is this flower pollinated by wind or insects? Write down the reasons for the last answer.

QUESTIONS

1. Why do insects visit flowers?
2. What do they carry from flower to flower?
3. What kind of flowers do insects visit?
4. How do big insects that cannot go down to the bottom of the flower get the honey?
5. On what parts of their bodies do insects carry pollen?
6. When an insect visits a second flower, where does it put the pollen from the first flower?
7. Tell me one way in which God has made a flower so that it must be cross-pollinated.
8. Why does an insect collect honey for a time from only one kind of flower?

CHAPTER XI

AN INSECT-POLLINATED FLOWER: THE COW PEA

The Journey of the Pollen in Cow Pea Flowers

In the cow pea flowers there are three kinds of petals. A big petal stands at the back of a flower like a flag. There are two side petals that bend out flat like wings. They make a table on which the insects stand. Two other petals are joined together in the shape of the keel of a boat. They are called the keel petals.

The ten stamens and the style and head of the ovary are folded inside the keel.

A butterfly goes to a cow pea flower. It stands on the wing petals. This pulls down the keel petals. They tear at the place where they are joined. The style and the stamens come suddenly out of the keel. The stigma touches the butterfly's body on the under side. There is pollen here from another flower. This sticks on to the stigma. At the same time the pollen from the stamens of this flower comes on to the insect. This is ready for the stigma of the next flower. In this way the pollen is carried from cow pea flower to cow pea flower.

THINGS TO DO

1. Name the three kinds of petals in the cow pea flower. Take a flower to pieces and draw the petals separately.
2. When you take away the petals, look at the ten stamens inside the keel, and the style. Draw the ten stamens standing on the flower stalk. The stalks of the stamens are joined to make a pipe.
3. Carefully pull off the stamens and the pipe. You will see the little ovary inside at the bottom, and the style lying inside the tube also. Draw this ovary and style.
4. Go round the garden and find cow pea flowers that have had the pollen taken from them by insects, and those that have not yet been visited. How do you know this?

QUESTIONS

1. How many stamens are there in a cow pea flower?
2. Which petals does a butterfly stand on when it visits a cow pea flower?
3. How many petals are joined to make the keel?
4. What is the big petal at the back of the flower called?
5. What part of the butterfly's body does the stigma touch?

CHAPTER XII

FERTILISATION

The Second Journey of the Pollen

The first journey of the pollen is from stamen to stigma. But here the pollen has not yet come to the ovules. It must come inside the ovary.

If we look at pollen under a magnifying glass, we shall see that it is like little grains of yellow powder. These grains are of different shapes in different flowers. Some are quite round. Some are long. Some are smooth. Some are rough. Some are bigger than others. But they are always very small and yellow. They are living.

The stigma is damp and often sticky with a juice. This juice gives water and food to the little living grains of pollen. Each little ball begins to grow. A very narrow pipe like a very fine root grows from each little pollen ball. It grows down the style to the ovary. It grows into the room of the ovary and goes to a little hole in the skin of an ovule. Each ball of pollen makes one pipe and goes to only one ovule.

Then the living inside part of each pollen ball moves down the pipe. In the pipe is juice. This little living thing swims in the juice, until it comes into the ovule.

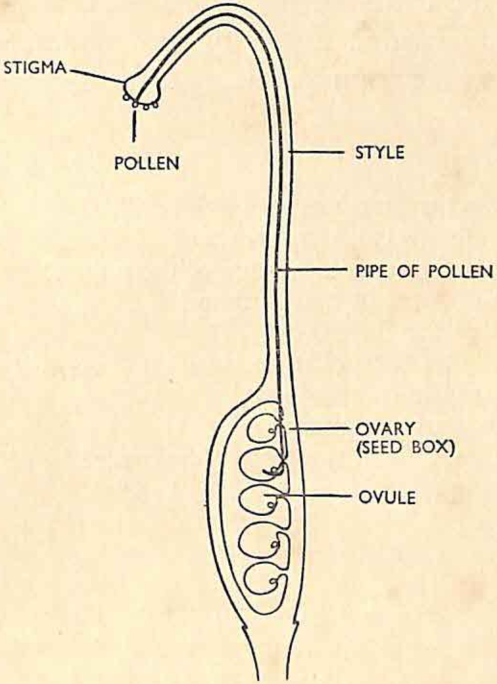

FIG. 13. TO SHOW THE FERTILISATION OF THE OVARY

Now the ovule changes. It begins to get bigger. The ovary gets bigger. Much plant food goes to the young seed to make it grow strong. Some of this is stored in the seed for food for the new young plant by and by. In the seed there is a very little root and shoot. The plant gives all its strength to the seeds that will be the new family.

When the seeds are ready to grow into new plants, the ovary is ripe. It is called a *fruit*. The seeds are carried away by men, animals, birds, wind or water to make new plants in other places.

QUESTIONS

1. What is the first journey of the pollen?
2. What do we call that journey?
3. What is the second journey of the pollen?
4. What do we call that journey?
5. What colour is pollen?
6. What helps the pollen to grow on the seed box head?
7. What grows down the style?
8. Where does this pipe go?
9. What goes down the pipe to the ovule?
10. Then what happens to the ovule?

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